[0055] **FIG. 28** is a simplified diagrammatic illustration showing an offset arrangement for an actuator assembly as shown in **FIG. 27**.

DESCRIPTION OF THE INVENTION

[0056] The most common method of reading Braille is to slide one or more fingertips across a line of Braille characters, relative motion of the Braille text and the fingertip being necessary for the sensation of touch that permits the most efficient reading of Braille. The user may tend to skip quickly over "expected" characters, and occasionally to backtrack to re-read or confirm some characters. Reading is usually on a word by word basis.

[0057] In its most general terms as shown in **FIG. 1**, the preferred embodiment of the invention described herein replaces a line of refreshable Braille characters with a rotatable assembly streaming text across a reading area, for example (in one embodiment) including a wheel or cylinder **27**. Wheel **27** (a cylinder, disk or the like) has an outer rim with height at its outer edge (or face) **29** at least equal to the height of a Braille character, with refreshable Braille characters definable at a selected surface characteristic **31** at tactile display surface **33** along outer edge **29** of the wheel **27** (around the cylinder face) and rotatable about the axis of the cylinder.

[0058] Wheel **27** is recessed into surface **35** of housing **37** so that only a small portion of the cylinder (for example, the width of two Braille characters) is exposed above surface **35** at a display area (or reading aperture) **39** (see **FIG. 2**). The user places a finger on the exposed surface of the wheel. Instead of the user sliding a finger along a motionless line of Braille characters, the rotation of the wheel causes the Braille characters to slide (or stream) past the finger, allowing them to be read.

[0059] With the primary objectives of this design in mind (to create a Braille reader with greater mechanical simplicity and reliability and at a lower cost than existing Braille readers), several alternative embodiments for implementation of the objectives are realized.

[0060] Actuators may be placed within cylinder **27** or along a shaft on which the cylinder rotates. Braille cells **41** are organized in sets of two characters **43**, with an even number of characters around cylinder **27**. Aperture **39** through which the user feels the Braille characters on display surface **33** of cylinder **27** is preferably of a width to allow no more than two characters to be felt at one time. With a six-dot Braille code, up to twelve actuators are used to control two character cells (depending upon design choice). For eight-dot code, up to sixteen actuators are used. At any given instant, all two character cell pairs around cylinder **27** are displaying the same pattern. Therefore, only twelve actuators are needed to control all cells **41** on cylinder **27**, with the motion from each actuator distributed to the corresponding Braille dot mechanism in all cells. The actuators are controlled by a computational device so that what the user feels through aperture **39** is a string of Braille characters. The actuators must therefore be fast enough to change the pattern of dots on a serial basis to provide the desired reading speed.

[0061] The method of distribution of actuator activity to its multiple corresponding dots may be by flexible cable directed through a channel, by solid linkages, or by a combination of the two. The greater the number of cells (character pairs) on cylinder **27**, the flatter reading surface **33** will seem to the user, but such an increase will also increase the size of the device, and the force the twelve actuators must provide to operate all the cells. The number of cells on cylinder **27** will be set by a design compromise of these factors.

[0062] As illustrated in **FIG. 2**, in an embodiment employing external actuator assembly **45** statically positioned at a station **47** of housing **37**, cylinder **27** contains no active components. The pattern of dots making up Braille characters is set in cooperation with surface characteristic **31** of cylinder **27** by external actuators **49** in assembly **45** (only one shown) before they move into reading aperture **39** for detection by the user. In this embodiment, six dots (for six-dot Braille code, arranged in two columns of three dots each) form each Braille cell (i.e., one character in six-dot Braille), and dots are arranged around display surface **33** in three endless rows (see **FIG. 1** for an example of this arrangement of rows, it being understood that for eight-dot Braille code eight dots arranged in two columns of four dots each form a cell, there being four endless rows arranged around display surface **33**). This allows the reader apparatus of this invention to operate with as few as three actuators **49** in the assembly creating a stream of Braille characters at reading aperture **39** as relative motion between surface **33** and actuator station **47** (in a direction substantially parallel to one another) continues. This represents a substantial reduction compared to the hundreds of actuators that may be required for existing readers (a slight increase in the number, for example to six actuators, may allow slower actuators to be used, by splitting the task of setting the dots).

[0063] There are several ways by which the Braille dots may be formed at display surface **33** (i.e., defining a selected surface characteristic **31**) of cylinder **27** by actuators **49**. The individual dots may be defined by numerous (one for each dot) spring-loaded push-on, push-off pin devices mounted in openings (corresponding to the dots) in cylinder **27** such as are used in certain pushbutton switches or in retractable ball-point pens. A push from an actuator shaft **51** causes an individual pin to switch state, from "in" (not extended from the cylinder surface) to "out" (extended from the cylinder surface), or vice versa. The controlling device preferably keeps track of the status of every dot in every cell on the cylinder, and when refreshing the text either reverses the status of dots or allows them to remain unchanged on a dot-by-dot basis, according to the requirements of the new text (though refreshing could occur merely by returning all pins to a default state after reading, for example the unextended position, by mechanical means before resetting by actuators **49** as discussed hereinafter).

[0064] Other passive mechanical means of forming the dots could be utilized. For example, pins shaped as small cylinders or spheres which are flattened on one side and which can be rotated about individual axes in openings in the cylinder by the actuators could be utilized. The cylinders or spheres would be shaped and contained so that rotation while passing across the user reading area and when being contacted by the user's fingers is prevented.

[0065] In yet another embodiment, the selected surface characteristic **31** of cylinder **27** can be a mechanically plastic